Radium sorption to iron bearing minerals in variable salinity waters

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Radium isotopes are a common naturally occurring radioactive material found in many subsurface regions. Recently, it has been of interest for studies of submarine groundwater discharge (SGD) [1] and is a significant hazard in waste waters produced by hydraulic fracturing operations [2]. In SGD, the flux of various radium isotopes can be used to estimate the total groundwater flux into or out of the ocean [3]. In the case of hydraulic fracturing, radium isotopes are a naturally occurring radioactive hazard liberated from shale formation waters during normal operation, creating a significant risk of release and cost for waste water treatment or disposal. In both of these scenarios, radium isotopes can sorb to the surrounding porous media, retarding the transport of the isotopes. For SGD studies, it is important to understand this sorption behavior to correctly estimate GW fluxes, while in hydraulic fracturing, increasing sorption by oxidation of formation iron minerals could immobilize radium. Some studies of radium sorption to various minerals have already been performed [4], but there is understanding of the surface chemistry of radium sorption, particularly to oxidized iron minerals such as Fe(OH)3 (ferrihydrite).

To this end, we present the results of sorption experiments of radium isotopes to iron bearing minerals including ferrihydrite and pyrite. We also analyze the impacts of varying salinity solutions through the use of artificial groundwater, seawater, and shale formation brine. We expect the salinity to have a significant impact on the sorption of radium, with high salinity solutions resulting in less sorption than low salinity solutions. This work lays the groundwork for further study of radium use as a tracer for SGD, as well as methods of immobilizing radium in hydraulic fracturing operations.

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